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Heather Darby
University of Vermont, heather.darby@uvm.edu

Hannah Harwood
University of Vermont

Erica Cummings
University of Vermont

Susan Monahan
University of Vermont

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Dr. Heather Darby, UVM Extension Agronomist
Hannah Harwood, Erica Cummings, and Susan Monahan
UVM Extension Crops and Soils Technicians
(802) 524-6501

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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2013 SUNFLOWER REDUCED TILLAGE TRIAL

Dr. Heather Darby, University of Vermont Extension
heather.darby[at]uvm.edu

Sunflowers are being grown in the Northeast for their potential to add value to a diversified operation as fuel, feed, fertilizer, and an important rotational crop. However, early season weed competition can limit the yields of sunflower crops, especially when wet or adverse soil conditions do not allow for mechanical cultivation in early summer. Planting sunflower into a freshly-terminated cover crop of winter rye could help reduce weed pressures. Winter rye would suppress weed germination by covering the ground early in the season, and also through the allelopathic compounds produced in the plants' roots, which inhibit germination of small-seeded plants. In addition, winter rye, a reliable and winter-hardy cover crop, benefits water quality and soil health, adding soil stability and organic matter between cash crops. Rye has the ability to scavenge nutrients from a previously fertilized and harvested crop, minimizing fertility inputs and keeping the ground covered through the winter.

Planting no-till sunflowers into winter rye could be a valuable Integrated Pest Management strategy. In addition to the potential benefits in weed mitigation, the practice may also help break the life cycles of sunflower disease. The most prevalent sunflower diseases in the Northeast are caused by *Sclerotinia* white mold, which drops black fungal bodies, called sclerotia, into the soil to overwinter. Because cereal crops like rye are not susceptible to the broadleaf's sclerotinia issues, the introduction of rye into the crop rotation could remove a host and relieve some disease pressures. In addition, sclerotia sitting on top of the soil (in a no-till system) degrade faster than when they are plowed under, as in conventional tillage. The reduction of weed and disease issues could increase sunflower yields and quality, resulting in a more productive and reliable crop.

MATERIALS AND METHODS

A trial was initiated at Borderview Research Farm in Alburgh, VT in 2013 to assess the yield and quality of sunflowers planted into a winter rye crop that had been mechanically terminated with a roller-crimper (Table 1). The replicated field trial included two treatments (no-till planting into roller-crimper terminated winter rye, and conventional planting into plowed rye) and three replications. The soil was a Covington silty clay loam with a 0-3% slope. Winter rye had been broadcast by hand in the fall of 2012.

Figure 1. Roger Rainville uses a roller-crimper to terminate a winter rye cover crop.

Each plot was 10' wide (4 rows of sunflowers on 30" rows), and 70' long. Winter rye was terminated mechanically on 10-Jun with a rear-mounted roller-crimper (Figure 1). In conventional plots, the seedbed was prepared with a spring disc, harrow, and spike tooth harrow to finish. Sunflowers were planted at a rate of 36,000 seeds per acre on 10-Jun with a John Deere 1750 MaxEmerge corn planter fitted with shorter sunflower finger pickups. The early-maturing Seeds 2000 variety 'Cobalt II' was used. Seeds were treated with the Cruiser Maxx® seed treatment, which is a mixture of thiamethoxam, azoxystrobin, fludioxonil, and mefnoxam.

Table 1. Agronomic field management of reduced tillage sunflower trial, 2013, Alburgh, VT.

Location	Borderview Research Farm – Alburgh, VT
Soil type	Covington silty clay loam, 0-3% slope
Previous crop	Winter rye
Treatments	Roller-crimper termination and no-till; conventional control
Replications	3
Plot size (ft)	10' x 70'
Sunflower variety	Cobalt II (Early RM)
Sunflower planting rate (seeds ac^{-1})	36,000
Row width (in.)	30
Planting equipment	John Deere 1750 MaxEmerge planter
Winter rye termination date	10-Jun
Sunflower planting date	10-Jun
Sunflower harvest date	21-Oct

Sunflower population was calculated and recorded on 10-Jul, one month after planting. Plots were harvested on 21-Oct with an Almaco SP50 plot combine with a 5' head and specialized sunflower pans made to efficiently collect sunflower heads. At harvest, test weight and seed moisture were determined for each plot with a Berckes Test Weight Scale and a Dickey-john M20P moisture meter. Oil from a known volume of each seed sample was extruded on 20-Nov with a Kern Kraft Oil Press KK40, and the oil quantity was measured to calculate oil content. Oil yield (in lbs per acre and gallons per acre) was adjusted to 10% pressing moisture and reported.

Data were analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications within the trial were treated as random effects and tillage treatments were treated as fixed. Mean comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was considered significant ($p<0.10$).

Variations in yield and quality can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among treatments is real or whether it might have occurred due to other variations in the field. At the bottom of each table a LSD value is presented for each variable (i.e. yield). Least Significant Differences (LSDs) at the 0.10 level of significance are shown, except where analyzed by pairwise comparison (t-test). Where the difference between two treatments within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure that for 9 out of 10 times, there is a real difference between the two treatments. Treatments that were not significantly lower in performance than the top-performing treatment in a particular column are indicated with an asterisk. In the example at right, hybrid C is significantly different from hybrid A but not from hybrid B. The difference between C and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these

Treatment	Yield
A	6.0
B	7.5*
C	**9.0***
LSD	2.0

hybrids did not differ in yield. The difference between C and A is equal to 3.0, which is greater than the LSD value of 2.0. This means that the yields of these hybrids were significantly different from one another. The asterisk indicates that hybrid B was not significantly lower than the top yielding hybrid C, indicated in bold.

RESULTS

Weather data was collected with an onsite Davis Instruments Vantage Pro2 weather station equipped with a WeatherLink data logger. Temperature, precipitation, and accumulation of Growing Degree Days (GDDs) are consolidated for the 2013 growing season (Table 2). Historical weather data are from 1981-2010 at cooperative observation stations in Burlington, VT, approximately 45 miles from Alburgh, VT.

For the most part, it was colder and wetter than average in the spring of 2013. In June 2013, there were 5.54 more inches of precipitation than normal. After June, however, the summer of 2013 was drier than normal, with an average of 5.20 inches fewer than average in July, August, and September. GDDs are calculated at a base temperature of 44°F for sunflowers. Between the months of planting and harvesting, there were an accumulated 2950 GDDs for sunflowers, 74 more than the 30-year average.

Table 2. Consolidated weather data and GDDs for sunflower, Alburgh, VT, 2013.

Alburgh, VT	June	July	August	September	October
Average temperature (°F)	64.0	71.7	67.7	59.3	51.1
Departure from normal	-1.8	1.1	-1.1	-1.3	2.9
Precipitation (inches)	9.23 *	1.89	2.41	2.20	2.39 ◊
Departure from normal	5.54	-2.26	-1.50	-1.44	-1.21
Growing Degree Days (base 44°F)	607	863	740	465	275
Departure from normal	-47	37	-27	-33	144

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger. Historical averages are for 30 years of NOAA data (1981-2010) from Burlington, VT.

* June 2013 precipitation data based on National Weather Service data from cooperative stations in South Hero, VT.

◊ October 2013 precipitation data based on National Weather Service data from cooperative stations in Burlington, VT.

Sunflower plant characteristics and yields were assessed for both no-till and conventional treatments (Table 3). In July, plant populations were significantly higher in the conventional sunflowers than in the no-till plots. Conventional populations were 27,646 plants per acre, as compared to 16,843 plants per acre in plots where winter rye was terminated to plant no-till sunflowers.

Table 3. Plant characteristics and yield for reduced tillage sunflowers, 2013, Alburgh, VT.

Tillage treatment	July population	Harvest moisture	Test weight	Seed yield at 13% moisture	Pressing moisture	Oil content	Oil yield at 10% moisture	
	plants ac^{-1}	%	lbs bu^{-1}	lbs ac^{-1}	%	%	lbs ac^{-1}	gal ac^{-1}
No-till	16843	**11.6**	**32.3**	641	7.67	**36.7**	243	31.9
Conventional	**27646***	10.5	30.2	**2072***	**8.20**	35.4	**728***	**95.3***
LSD (0.10)	9326	NS	NS	1065	NS	NS	475	62.2
Trial mean	22245	11.1	31.3	1357	7.93	36.0	486	63.6

NS – Treatments were not significantly different from one another (p=0.10).
* Treatments indicated with an asterisk performed significantly greater than the other treatment in a particular column (p=0.10).
Treatments shown in **bold** are top-performing in a particular column.

Sunflowers were harvested at an average moisture level of 11.1%. Though conventional sunflowers were drier than no-till sunflowers at harvest, the difference was not statistically significant. Test weight, an indicator of seed plumpness and overall quality, was higher in no-till sunflowers (32.3 lbs per bushel), but not significantly different than the conventional treatment. The seed yield varied significantly by tillage treatment, with greater yields in conventional sunflowers (2072 lbs per acre at 13% moisture). There was no significant difference in pressing moisture or oil content, but overall oil yield was significantly greater in conventional sunflowers (Figure 2). The trial average was 486 lbs (63.6 gallons) of oil per acre.

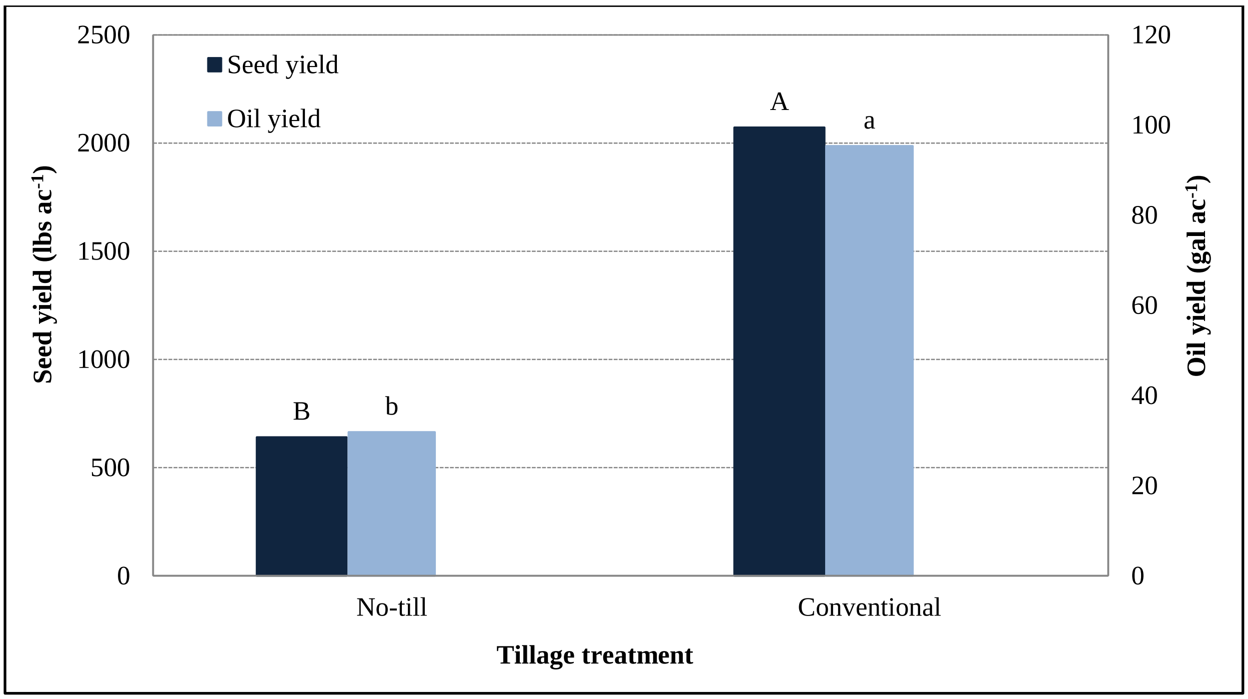

Figure 2. Impact of tillage treatment on sunflower seed and oil yields. Treatments that share a letter were not significantly different from one another (p=0.10; compare capital letters for seed yield and lower-case letters for oil yield).

DISCUSSION

There was a significant difference in plant population between no-till and conventional sunflowers, indicating that sunflowers planted into winter rye did not become established as vigorously. Conventional populations were 27,646 plants per acre; reduced tillage sunflowers averaged 16,843 plants per acre. Given the 36,000 seeds per acre planting rate, this is a 76.8% survival rate for conventional and 46.8% survival rate for reduced tillage sunflowers. Timing the mechanical termination of a rye crop is essential; earlier crimping may result in more successful emergence and stand establishment of sunflower plants. It is also possible that a higher seeding rate should be used when planting no-till sunflowers into a terminated rye crop. Lastly, modifications to the planter may be essential to improve sunflower establishment rates in this type of no-till system. Residue cleaners and aggressive coulters may help clean rye residue from the planted area allowing sunflowers to easier establish. Lower plant populations and spotty plant stands led to reduced seed yields and, despite slightly higher oil content in no-till sunflowers, overall oil yields that were significantly lower in no-till sunflowers than in conventionally-planted sunflowers.

This trial evaluated the impact of the reduced-tillage practice of terminating a winter rye crop with a roller-crimper and planting sunflowers with a no-till planter. While this no-till practice did not produce competitive sunflower seed and oil yields in 2013, the rye cover crop in both treatments benefitted soil health and may have reduced overall weed pressures. It is important to remember that these data represent results from only one year in one location. More research on reduced tillage practices in sunflower crops could result in helpful cultural control of weeds and disease, potentially increasing sunflower yields and enhancing soil health.

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